

REPRODUCTIVE BEHAVIOR IN MERRIAM'S CHIPMUNK (*TAMIAS MERRIAMI*)

Stephen B. Compton¹ and J. R. Callahan²

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The literature contains little information regarding mating chases and copulation in any of the western chipmunks (*Tamias*, subgenus *Neotamias*). Callahan (1981) reported mating chases for Merriam's (*T. merriami*) and dusky chipmunks (*T. obscurus*), but noted (unpublished) that both copulating pairs were partly concealed by foliage. Larson (1981) described two copulations for Merriam's chipmunk, but a careful reading suggests that one of these was a mounting attempt by an immature male and the other was observed from a considerable distance. Best and Granai (1994) found no references on this subject other than Callahan (1981) and Larson (1981).

There has been some speculation and difference of opinion regarding reproductive isolating mechanisms in parapatric species of western chipmunks. Blankenship and Brand (1987) reported differences in vocal behavior between *Tamias merriami* and *T. obscurus* at Black Mountain (Riverside County, CA) and noted a possible role in reproductive isolation. One of us (JRC), however, had previously conducted a more extensive study of vocal behavior in these two cryptic species at Black Mountain from 1975 to 1980. Vocalizing individuals were collected to confirm species identity, and sonograms were prepared and measured; yet no statistically significant vocal differences were found (Callahan 1981, and in preparation). Ecological, olfactory, and mechanical barriers to hybridization also have been suggested (Callahan 1977, 1981, Patterson 1984). These hypotheses cannot be tested without more data on chipmunk reproductive behavior. Accordingly, this note provides the first detailed description of western chipmunk copulation that has been published, to the best of our knowledge. Comparative data for other western chipmunk species would be of interest.

The observation was made 1 April 1994 in a wooded residential area in Idyllwild, Riverside County, CA (elevation 1590 m), between 1000 and 1130 h. The habitat is mixed-conifer forest dominated by incense cedar (*Calocedrus decurrens*), yellow pine (*Pinus ponderosa*), live oak (*Quercus chrysolepis*), and black oak (*Q. kelloggii*), with a sparse understory of chaparral shrubs. When the observer arrived at 1000 h, six to seven Merriam's chipmunks, many of them males, were running over, around, and through a large woodpile while performing conspicuous leaping maneuvers. No agonistic interaction was observed. It was not possible at this stage to identify the female(s) or to tell in which direction the "chase" was headed. The overall effect was somewhere between a *Sciurus*-like mating chase (e.g., Thompson 1977), in which several males follow one female, and a lek, involving male display. The chase covered an area 13–15 m in diameter but centered on the woodpile and a nearby heap of smaller pine branches.

After about 20 min, one chipmunk (later identified as female) ran up on one of the piled branches. A second chipmunk approached and they ran around for a few seconds. The female stopped on a branch and the other chipmunk, a male, ran up beside her. His entire right side was in contact with her left side for about 1 sec, during which he made a nuzzling motion with the right side of his face on the rear left portion of her face. The expected nasal/genital contact was not observed, but the pair had been out of sight for a short time previously and this could have occurred. The female then jumped to another branch, which was 5 cm in diameter and 20 cm above the ground, sloping at a 25° angle so that the female was facing downhill. Copulation then occurred only 2 m from the observer (who was inside a parked vehicle).

¹Send reprint requests to Box 3140, Hemet, CA 92546.

²Museum of Southwestern Biology, University of New Mexico, Albuquerque, NM 87131.

The female crouched on the branch as if resting. The male jumped to that branch and quickly grasped the female from the rear with his forelimbs around her pectoral region. The female's tail was deflected to the side and slightly raised, and the male's tail was extended to the rear. Copulation consisted of four series of pelvic thrusts. Each series (except the last) lasted about 4 sec and comprised an estimated 12–24 thrusts, at a rate of 3–6 per sec. Each series of rapid thrusts was followed by a short resting period, during which the male stopped thrusting and brushed his face (mouth, nose, and chin) from side to side 2–4 times against the back of the female's neck. The fourth and last series of thrusts was shorter than the first three. The male then released his grip on the female, dismounted, and ran off into the woodpile. The female, who had remained motionless during the act, remained on the branch about 1 sec and then also ran to the woodpile. The entire copulation lasted about 18 sec.

Although several male chipmunks participated in the chase, none of them approached the copulating pair. No chipmunks were heard vocalizing during the mating chase or copulation. We did not note any pre-mating vocal display or *Lockrufe* by the estrous female (Callahan 1981), but we were not present on the days when the display (if any) would have taken place. The *Tamias* vocal display has been reported for a few species of chipmunks by Callahan (1981), Blake (1992), and others. It is not clear whether this vocal display is universal or occurs only at low population densities, when the female benefits by attracting more distant males.

No further copulations were seen, but as many as seven male chipmunks continued to run around the same woodpile for another hour. The level of activity appeared to decrease, and there were none of the prodigious leaps seen earlier. The group then gradually dispersed as individuals headed for an adjacent area where other chipmunks were heard giving occasional "chipper" vocalizations (not the long series of chips that characterizes the *Lockrufe*).

The behavior described above suggests that scent glands play a key role in reproductive behavior of this species. Larson (1981) and others have noted that male chipmunks have scent glands near the chin and angle of the jaw (oral glands) that become enlarged during the

breeding season. Scent marking is prevalent in sciurids, but usually this means marking the ground or a branch, not marking another animal. The "nuzzling" and "brushing" behavior of the male Merriam's chipmunk, before and during copulation, suggests that he was scent marking the female.

Conspecific marking has been described for various mammals, such as rabbits (Mykutowycz 1965), but not for sciurids. Gurnell (1987) describes "face-wiping" behavior by various tree squirrels, but only in the context of substrate marking and (in *Paraxerus*) self-grooming; his description of copulation in *Sciurus* and *Tamiasciurus* says nothing about the male marking the female. With reference to olfactory communication in ground squirrels, Halpin (1984) wrote that "there is no experimental evidence that conspecific marking . . . actually occur[s] among the sciurids."

Our observation indicates that conspecific marking does occur in Merriam's chipmunk as a component of reproductive behavior. Without experimental data, it is not possible to determine the significance of this marking. Pair bonding comes to mind, but there is no good evidence of long-term pair bonding in Merriam's or any other species of western chipmunk, despite many years of field observation. Other possibilities include the following: (1) the marking induces some required physiological state in the female; (2) the marking tells other males that the female has already mated (before the copulation plug forms and the message becomes redundant); or (3) the marking reinforces a short-term pair bond to ensure that subsequent copulations (if any) on the day of estrus will be with the same male. Larson (1981) indicated that the same estrous female sometimes copulates more than once.

Mortality from all causes is higher for male than for female chipmunks (Smith 1978), perhaps due in part to the dispersal and exposure associated with the breeding season (Callahan 1981). After incurring the risk of predation and expending considerable energy on the mating chase, it should be to the male's advantage to ensure that his genes are passed to all the female's offspring of the season.

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